

US-PAT-NO: 6321263

DOCUMENT-IDENTIFIER: US 6321263 B1

TITLE: Client-based application availability

DATE-ISSUED: November 20, 2001

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	
COUNTRY				
Luzzi; Joseph	Ridgefield	CT	N/A	N/A
Reps; Steven M.	Bethel	CT	N/A	N/A
Zhu; Gengxin	Southbury	CT	N/A	N/A

US-CL-CURRENT: 709/224, 702/186

ABSTRACT:

In a distributed computing environment, a method, system and program product for monitoring, from a client computer system the performance of an application program residing on a server computer system. A probe program residing at the client computer generates requests for the services of the application program and records transaction records based upon service responses therefrom. The requests and transaction record generation is controlled by a set of probe configuration information at the client computer. Transaction records are provided to a central repository whereat statistical information is pre-processed and inserted into statistics tables. A display system enables a computer user to interactively request and view a plurality of displays of data sets of the monitoring data. Each data set includes data elements which may be interactively indicated by the viewer to cause the retrieval and display of related data sets having data elements associated with those in the original display.

33 Claims, 18 Drawing figures

Exemplary Claim Number: 1

Number of Drawing Sheets: 18

----- KWIC -----

Brief Summary Text - BSTX (2):

The present invention is generally related to the field of network system service, and particularly to an end-user based application availability and response monitoring and alerting system, method and program product. More specifically, the present invention enables the monitoring of availability and response time or other desired performance metrics of an application program from the perspective of an end-user utilizing the application program over a distributed computing network. Additionally, the invention provides a readily accessible reporting system for dynamically communicating the real-time results of the application program monitoring. The monitoring system is implemented such that it is not platform specific, does not impact the performance of the monitored applications, and permits easy maintenance. The reporting system enables real-time analysis of the monitoring results, via graphical display, at a variety of levels of granularity available to any user of the network from a

central repository thereon. Additionally, the invention includes facilities for establishing performance thresholds for the application program and for determining when the established thresholds have been violated which may indicate performance aberrations of the program. The invention further provides alert signals indicative of the threshold violation to a service or support entity so as to quickly provide the appropriate services to the poorly functioning application.

Brief Summary Text - BSTX (7):

In many instances an information technology services (IT) organization either within or outside of the enterprise is charged with the responsibility for managing the distributed computing environment. Typically, a service level agreement (SLA) with such an agency specifies an expected level of application availability and response time for the users of such a network. Adherence to these expected baseline levels is required to fulfill contractual obligations and the failure to achieve these baselines may directly result in the loss of a customer's business. Accordingly, an application monitoring system which provides real-time data regarding application availability and response time would be an invaluable asset to such an organization.

Brief Summary Text - BSTX (9):

A number of passive monitoring systems exist for gathering available data from servers and/or clients in a distributed computing system.

Brief Summary Text - BSTX (10):

For example, U.S. Pat. No. 4,858,152 to Estes for "Operator Access To Monitoring Applications" (issued Aug. 15, 1989 and assigned to the present assignee) teaches a microcomputer-based monitoring system for concurrently monitoring a plurality of host applications running on a mainframe computer, for summarizing the monitored information and for graphically displaying the information on the display screen of a microcomputer system as well as to provide an alarm mechanism for indicating the attainment of user-defined thresholds. The Multiple System Application Monitor (MSAM) taught by Estes receives existing summarized information from the host machine and reduces the information to an accurate picture of the applications running on the host.

Brief Summary Text - BSTX (12):

The aforementioned patents, while offering valuable information to a network manager, do not, by themselves, test application availability or response times, but rather they depend upon data being generated by other parts of the system. In the case of Estes, the information is already available at the host for provision to the microcomputer, and in Chen et al., the system statistical data is captured at the server and provided to the data collector. Thus, in both cases these monitoring tools do not generate relevant client-based availability information and are constrained to collecting and reporting pre-existing information on system performance. If no relevant data on application availability and response time from a client's perspective is previously available for these tools, they will not satisfy the objectives of the data manager.

Brief Summary Text - BSTX (13):

Several monitoring systems disclose mechanisms for independently generating information indicative of the status of the distributed computing system and collecting and reporting the generated information.

Brief Summary Text - BSTX (16):

U.S. Pat. No. 5,675,798 to Chang for "System And Method For Selectively And Contemporaneously Monitoring Processes In A Multiprocessing Server" (issued

Oct. 7, 1997 and assigned to the present assignee) teaches a monitoring system wherein information regarding the status of each client's application program, as it is reflected by a server process, is acquired and made available to the network administrator. The server process monitor program provides information to the network administrator at the granularity level of each client's process within the client-server network.

Brief Summary Text - BSTX (17):

In each of the foregoing examples, the monitoring system requires an intrusive monitor or probe installed at the server level either in the application program running on the server as in Skagerling, or running on the server in a supervisory mode to collect information from monitored applications running thereon. In either case, the results of the probe are not instructive as to the experience of the client since the information is being generated and gathered on the server side of the network rather than the client side. Moreover, the addition of this monitoring code to servers running in the network creates the same maintenance problems as, and may simply be thought of, as adding yet another application to each of the servers. Furthermore, the execution of these monitoring programs may substantially degrade the performance of their host servers, and in turn the networks that they serve, with the dichotomous result that in the name of efficiently managing the network the very tool being used to achieve that objective creates an inefficient network.

Brief Summary Text - BSTX (18):

From the foregoing it can be seen that a new application monitoring system which generates availability and response time information or any other desired application program metrics from the perspective of a client would be of great value to a network administrator. The system should be designed to be implemented as a probe at any point within a complex distributed computing environment at which a client computer system may be coupled, and the function of the probe should have negligible impact on the performance of the network. The system should be customizable to provide real time alert signals alerting a recipient of the traversal of user-defined thresholds such as a maximum tolerable response time or minimum availability of a monitored application program.

Brief Summary Text - BSTX (19):

The monitoring system should provide dynamic reports on, for example, application program availability and response time, which can be tailored by the observer to display in graphical or tabular form the real-time and archived monitoring information relevant to the particular observer. The reports should be displayed in such a manner that the viewer may display either via a graph or table or otherwise data relating to the performance of many servers and/or applications and should provide an interactive facility for enabling the viewer to "drill-down" to view data on specific servers or applications and/or to drill up therefrom to a broader view of the performance data.

Drawing Description Text - DRTX (9):

FIG. 7 and 7a illustrate a display screen for a front-end graphical user interface for the viewer's computer showing scalable measurements of application availability and response time for a Lotus Notes application program running on all listed servers for the Poughkeepsie site for the month of February 1998;

US-PAT-NO: 6370573

DOCUMENT-IDENTIFIER: US 6370573 B1

TITLE: System, method and article of manufacture for managing
an environment of a development architecture framework

DATE-ISSUED: April 9, 2002

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE
Bowman-Amuah; Michel K.	Colorado Springs	CO	N/A

US-CL-CURRENT: 709/223

ABSTRACT:

A system, method and article of manufacture are provided for managing an environment in a development architecture framework. Service of a system is managed based on service level agreements and/or operations level agreements. A plurality of system management operations are performed. The system management operations include start-up and shut-down operations, back-up and restore operations, archiving operations, security operations, and performance monitoring operations. Service is planned in order to anticipate and implement changes in the system.

15 Claims, 14 Drawing figures

Exemplary Claim Number: 1

Number of Drawing Sheets: 14

----- KWIC -----

Detailed Description Text - DETX (17):

Programming languages are beginning to fully support the OOP principles, such as encapsulation, inheritance, polymorphism, and composition-relationship. With the advent of the C++ language, many commercial software developers have embraced OOP. C++ is an OOP language that offers a fast, machine-executable code. Furthermore, C++ is suitable for both commercial-application and systems-programming projects. For now, C++ appears to be the most popular choice among many OOP programmers, but there is a host of other OOP languages, such as Smalltalk, Common Lisp Object System (CLOS), and Eiffel. Additionally, OOP capabilities are being added to more traditional popular computer programming languages such as Pascal.

Detailed Description Text - DETX (582):

In the development environment, it may be possible to outsource certain Systems Management tasks. For example, the LAN supplier may be willing to take responsibility for LAN support, upgrades, and so on. Similarly, an existing data processing center may be willing to take responsibility for host operations. Such agreements are very beneficial and make it possible to use project team members more effectively. However, outsourcing the development environment carries a risk, which can be mitigated by defining a Service Level Agreement with the provider. This will generally be very similar to the SLA established between the Environment Management team and the developers. One

important difference is that punitive measures (to be applied if the SLA is not respected) must be specified to ensure that outside suppliers are strongly motivated to abide by the agreement.

Detailed Description Text - DETX (1533):

Prototypes may also be used to prove architecture concepts (for example, to verify the flow of messages from the client to the host), to ensure that the system is not based on an architecture that is fundamentally flawed.

Detailed Description Text - DETX (1683):

The tool should be scalable to support growth in application size, users, and developers.

Detailed Description Text - DETX (2145):

Problems can be logged both as a result of one or more incidents, or through proactive monitoring of the system, before any incidents have been logged.

Detailed Description Text - DETX (2439):

The number of security components required to secure a distributed environment will increase due to the computing power available through the use of these new technologies and the heterogeneity of the environment. Although things such as dial-up access, LAN access, multiple host access, etc. introduce new user capabilities, they simultaneously introduce security risks into the system.

Detailed Description Text - DETX (2563):

The release library may reside on several platforms. UNIX software may be stored on UNIX servers, host software on hosts and third party workstation software may be on floppy disks.

Detailed Description Text - DETX (2639):

May require use of some or all of the following monitoring tools: operating system monitor, on-line monitor, batch monitor, data base monitor, (host, server) and network monitor (WAN, LAN).

Detailed Description Text - DETX (2693):

File transfers in a distributed environment are not confined between hosts. File transfers can take place in a bidirectional fashion between hosts, servers and workstations. Due to the geographical disparity and number of devices in these environments, file transfers will increase the traffic over the network and will require careful scheduling to ensure that the necessary file transfers take place amidst the rest of the processing.

US-PAT-NO: 6055363

DOCUMENT-IDENTIFIER: US 6055363 A

TITLE: Managing multiple versions of multiple subsystems in a distributed computing environment

DATE-ISSUED: April 25, 2000

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE
Beals; Stephanie A.	Poughkeepsie	NY	N/A
Briskey; Kenneth C.	Hyde Park	NY	N/A
Russell; Richard C.	Red Hook	NY	N/A

US-CL-CURRENT: 709/201, 717/170 , 717/174

ABSTRACT:

A parallel distributed computing system having a plurality of processors connected in a network of nodes, each node having software installed thereon, and a control workstation controlling the nodes in the network. A list of the levels of the software installed at each node is stored at the control workstation. A list of software subsystems affected by a command to be executed is stored at the nodes of the network, including the control workstation. In addition, a control script for each of said software subsystems is stored at the nodes, including the control workstation. Each control script provides a routine to be followed for the associated subsystem on the associated node or control workstation during the execution of the command. Since the control scripts are compatible with the level of software installed on the target node, the command will be performed such as to be compatible with the software installed on the target node.

50 Claims, 28 Drawing figures

Exemplary Claim Number: 11

Number of Drawing Sheets: 27

----- KWIC -----

Brief Summary Text - BSTX (3):

A parallel, distributed computing system, such as the IBM RISC/System 6000 Scalable POWERparallel Systems SP computer, contains multiple host computer systems or nodes, each running the AIX operating system (the IBM version of the UNIX operating system) and the IBM Parallel System Support Programs (PSSP) package of system support software. The nodes are grouped into one or more system partitions, each of which represents a logical domain which portrays a virtual SP environment. Introduced with PSSP version 2.2, each node in a system partition may run any supported level of operating system software (AIX). In addition, each node in the system partition may run any level of support software (PSSP) supported by the level of operating system running on that node.



US Patent & Trademark Office

[Subscribe \(Full Service\)](#) [Register \(Limited Service, Free\)](#) [Login](#)

 Search: ☒ The Guide ☐ The ACM Digital Library

THE GUIDE TO COMPUTING LITERATURE

[Feedback](#) [Report a problem](#) [Satisfaction survey](#)

 Terms used [performance metrics](#) [scalable application](#) [networked hosts](#)

Found 2 of 661,433

Sort results by


[Save results to a Binder](#)
[Try an Advanced Search](#)

Display results


[Search Tips](#)
[Try this search in The Digital Library](#)
☐ Open results in a new window

Results 1 - 2 of 2

 Relevance scale ☐ ☐ ☐ ☐ ☐
1 Trust management for IPsec

 May 2002 **ACM Transactions on Information and System Security (TISSEC)**, Volume 5 Issue 2

 Full text available: [pdf\(321.98 KB\)](#)

 Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#), [review](#)

IPsec is the standard suite of protocols for network-layer confidentiality and authentication of Internet traffic. The IPsec protocols, however, do not address the policies for how protected traffic should be handled at security end points. This article introduces an efficient policy management scheme for IPsec, based on the principles of trust management. A compliance check is added to the IPsec architecture that tests packet filters proposed when new security associations are created for confo ...

Keywords: Credentials, IPsec, KeyNote, network security, policy, trust management

2 Software engineering and middleware: a roadmap

Wolfgang Emmerich

 May 2000 **Proceedings of the conference on The future of Software engineering**

 Full text available: [pdf\(1.34 MB\)](#)

 Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)

Results 1 - 2 of 2

The ACM Portal is published by the Association for Computing Machinery. Copyright © 2003 ACM, Inc.

[Terms of Usage](#) [Privacy Policy](#) [Code of Ethics](#) [Contact Us](#)

 Useful downloads: [Adobe Acrobat](#)

[QuickTime](#)

[Windows Media Player](#)

[Real Player](#)


[Subscribe \(Full Service\)](#) [Register \(Limited Service, Free\)](#) [Login](#)

 Search: ☒ The Guide ☐ The ACM Digital Library

THE GUIDE TO COMPUTING LITERATURE

 [Report a problem](#) [Satisfaction survey](#)

 Terms used [performance metrics](#) [scalable application](#) [hosts](#) [network](#)

Found 1 of 661,433

Sort results by

☒ [Save results to a Binder](#)
[Try an Advanced Search](#)

Display results

☒ [Search Tips](#)
[Try this search in The Digital Library](#)
☐ Open results in a new window

Results 1 - 1 of 1

 Relevance scale ☐ ☐ ☐ ☐ ☐

1 The AppLeS parameter sweep template: user-level middleware for the grid

Henri Casanova, Graziano Obertelli, Francine Berman, Rich Wolski

 November 2000 **Proceedings of the 2000 ACM/IEEE conference on Supercomputing (CDROM)**

 Full text available: ☒ pdf(256.33 KB)

 Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)
☒ [Publisher Site](#)

The Computational Grid is a promising platform for the efficient execution of parameter sweep applications over large parameter spaces. To achieve performance on the Grid, such applications must be scheduled so that shared data files are strategically placed to maximize re-use, and so that the application execution can adapt to the deliverable performance potential of target heterogeneous, distributed and shared resources. Parameter sweep applications are an important class of applications ...

Keywords: Application Level Scheduling, Adaptive Runtime Scheduling, Computational Grid, Grid Middleware, Parameter Sweeps Applications, Scheduling Heuristics, Distributed Storage.

Results 1 - 1 of 1

The ACM Portal is published by the Association for Computing Machinery. Copyright © 2003 ACM, Inc.

[Terms of Usage](#) [Privacy Policy](#) [Code of Ethics](#) [Contact Us](#)

 Useful downloads: ☒ [Adobe Acrobat](#)
☒ [QuickTime](#)
☒ [Windows Media Player](#)
☒ [Real Player](#)

**IEEE Xplore[®]**
RELEASE 1.5Welcome
United States Patent and Trademark Office[Help](#) [FAQ](#) [Terms](#) [IEEE Peer Review](#)[Quick Links](#)

» Search Results

Welcome to IEEE Xplore[®]

- ☐ Home
- ☐ What Can I Access?
- ☐ Log-out

Tables of Contents

- ☐ Journals & Magazines
- ☐ Conference Proceedings
- ☐ Standards

Search

- ☐ By Author
- ☐ Basic
- ☐ Advanced

Member Services

- ☐ Join IEEE
- ☐ Establish IEEE Web Account
- ☐ Access the IEEE Member Digital Library

Print Format

Your search matched **1** of **950522** documents.A maximum of **1** results are displayed, **25** to a page, sorted by **Relevance** in **descending** order.

You may refine your search by editing the current search expression or entering a new one in the text box.

Then click **Search Again**.**Search Again****Results:**Journal or Magazine = **JNL** Conference = **CNF** Standard = **STD****1 Exploiting the predictability of TCP's steady-state behavior to speed up network simulation***He, Q.; Ammar, M.; Riley, G.; Fujimoto, R.;*

Modeling, Analysis and Simulation of Computer and Telecommunications Systems, 2002. MASCOTS 2002. Proceedings. 10th IEEE International Symposium on , 11-16 Oct. 2002

Page(s): 101 -108

[\[Abstract\]](#) [\[PDF Full-Text \(946 KB\)\]](#) **IEEE CNF**

[Home](#) | [Log-out](#) | [Journals](#) | [Conference Proceedings](#) | [Standards](#) | [Search by Author](#) | [Basic Search](#) | [Advanced Search](#)
[Join IEEE](#) | [Web Account](#) | [New this week](#) | [OPAC Linking Information](#) | [Your Feedback](#) | [Technical Support](#) | [Email Alerting](#)
[No Robots Please](#) | [Release Notes](#) | [IEEE Online Publications](#) | [Help](#) | [FAQ](#) | [Terms](#) | [Back to Top](#)

Copyright © 2003 IEEE — All rights reserved

**IEEE Xplore[®]**
RELEASE 1.5Welcome
United States Patent and Trademark Office[Help](#) [FAQ](#) [Terms](#) [IEEE Peer Review](#)[Quick Links](#)

» Search Re:

Welcome to IEEE Xplore[®]

- ☐ Home
- ☐ What Can I Access?
- ☐ Log-out

Tables of Contents

- ☐ Journals & Magazines
- ☐ Conference Proceedings
- ☐ Standards

Search

- ☐ By Author
- ☐ Basic
- ☐ Advanced

Member Services

- ☐ Join IEEE
- ☐ Establish IEEE Web Account
- ☐ Access the IEEE Member Digital Library

Print Format

Your search matched **15** of **950522** documents.A maximum of **15** results are displayed, **25** to a page, sorted by **Relevance** in **descending** order.

You may refine your search by editing the current search expression or entering a new one the text box.

Then click **Search Again**.

performance metrics and scalable and application

[Search Again](#)**Results:**Journal or Magazine = **JNL** Conference = **CNF** Standard = **STD****1 Virtual reality and parallel systems performance analysis***Reed, D.A.; Shields, K.A.; Scullin, W.H.; Tavera, L.F.; Elford, C.L.;*

Computer , Volume: 28 Issue: 11 , Nov. 1995

Page(s): 57 -67

[\[Abstract\]](#) [\[PDF Full-Text \(984 KB\)\]](#) **IEEE JNL****2 CMOS technology for MS/RF SoC***Diaz, C.H.; Tang, D.D.; Sun, J.Y.-C.;*

Electron Devices, IEEE Transactions on , Volume: 50 Issue: 3 , March 2003

Page(s): 557 -566

[\[Abstract\]](#) [\[PDF Full-Text \(874 KB\)\]](#) **IEEE JNL****3 Fault tolerant maintenance networks for highly reliable WSI systems***Landis, D.L.; Schramm, L.E.; Check, W.A.;*

Communications, 1990. ICC 90, Including Supercomm Technical Sessions.

SUPERCOMM/ICC '90. Conference Record., IEEE International Conference on , 16-19

April 1990

Page(s): 791 -795 vol.3

[\[Abstract\]](#) [\[PDF Full-Text \(608 KB\)\]](#) **IEEE CNF****4 Selective monitoring using performance metric predicates***Fineman, C.E.; Hontalas, P.J.;*

Scalable High Performance Computing Conference, 1992. SHPCC-92. Proceedings. ,

26-29 April 1992

Page(s): 162 -165

[\[Abstract\]](#) [\[PDF Full-Text \(304 KB\)\]](#) **IEEE CNF**

5 Benchmarking multilevel secure database systems using the MITRE benchmark

Doshi, V.M.; Herndon, W.R.; Jajodia, S.; McCollum, C.D.;

Computer Security Applications Conference, 1994. Proceedings., 10th Annual , 5-9 Dec. 1994

Page(s): 86 -95

[\[Abstract\]](#) [\[PDF Full-Text \(804 KB\)\]](#) **IEEE CNF**

6 Performance metrics for configurable computing

Spaenenburg, H.;

System Sciences, 1997, Proceedings of the Thirtieth Hawaii International Conference on , Volume: 1 , 7-10 Jan. 1997

Page(s): 720 vol.1

[\[Abstract\]](#) [\[PDF Full-Text \(88 KB\)\]](#) **IEEE CNF**

7 The performance of multicast banyan networks

Yuanyuan Yang;

Computer Communications and Networks, 1997. Proceedings., Sixth International Conference on , 22-25 Sept. 1997

Page(s): 51 -59

[\[Abstract\]](#) [\[PDF Full-Text \(1136 KB\)\]](#) **IEEE CNF**

8 Stretch-optimal scheduling for on-demand data broadcasts

Yiqiong Wu; Guohong Cao;

Computer Communications and Networks, 2001. Proceedings. Tenth International Conference on , 15-17 Oct. 2001

Page(s): 500 -504

[\[Abstract\]](#) [\[PDF Full-Text \(168 KB\)\]](#) **IEEE CNF**

9 A case for scalable multicast tree migration

Chakrabarti, A.; Manimaran, G.;

Global Telecommunications Conference, 2001. GLOBECOM '01. IEEE , Volume: 3 , 25-29 Nov. 2001

Page(s): 2026 -2030 vol.3

[\[Abstract\]](#) [\[PDF Full-Text \(130 KB\)\]](#) **IEEE CNF**

10 On service level agreements for IP networks

Martin, J.; Nilsson, A.;

INFOCOM 2002. Twenty-First Annual Joint Conference of the IEEE Computer and Communications Societies. Proceedings. IEEE , Volume: 2 , 23-27 June 2002
Page(s): 855 -863 vol.2

[\[Abstract\]](#) [\[PDF Full-Text \(979 KB\)\]](#) **IEEE CNF**

11 Cplant/sup /spl trade// runtime system support for multi-processor and heterogeneous compute nodes

Pedretti, K.; Brightwell, R.; Williams, J.;

Cluster Computing, 2002. Proceedings. 2002 IEEE International Conference on , 23-26 Sept. 2002

Page(s): 207 -214

[\[Abstract\]](#) [\[PDF Full-Text \(276 KB\)\]](#) **IEEE CNF**

12 Models and scheduling mechanisms for global computing applications

Kondo, D.; Casanova, H.; Wing, E.; Berman, F.;

Parallel and Distributed Processing Symposium., Proceedings International, IPDPS 2002, Abstracts and CD-ROM , 15-19 April 2002

Page(s): 79 -86

[\[Abstract\]](#) [\[PDF Full-Text \(1176 KB\)\]](#) **IEEE CNF**

13 Scalable hardware priority queue architectures for high-speed packet switches

Sung-Whan Moon; Rexford, J.; Shin, K.G.;

Computers, IEEE Transactions on , Volume: 49 Issue: 11 , Nov. 2000

Page(s): 1215 -1227

[\[Abstract\]](#) [\[PDF Full-Text \(376 KB\)\]](#) **IEEE JNL**

14 Performance metrics for oceanographic surveys with autonomous underwater vehicles

Willcox, J.S.; Bellingham, J.G.; Yanwu Zhang; Baggeroer, A.B.;

Oceanic Engineering, IEEE Journal of , Volume: 26 Issue: 4 , Oct. 2001

Page(s): 711 -725

[\[Abstract\]](#) [\[PDF Full-Text \(339 KB\)\]](#) **IEEE JNL**

15 Scalable proxy caching for video under storage constraints

Zhourong Miao; Ortega, A.;

Selected Areas in Communications, IEEE Journal on , Volume: 20 Issue: 7 , Sep 2002

Page(s): 1315 -1327

[\[Abstract\]](#) [\[PDF Full-Text \(447 KB\)\]](#) **IEEE JNL**

[Home](#) | [Log-out](#) | [Journals](#) | [Conference Proceedings](#) | [Standards](#) | [Search by Author](#) | [Basic Search](#) | [Advanced Search](#)
[Join IEEE](#) | [Web Account](#) | [New this week](#) | [OPAC Linking Information](#) | [Your Feedback](#) | [Technical Support](#) | [Email Alerting](#)
[No Robots Please](#) | [Release Notes](#) | [IEEE Online Publications](#) | [Help](#) | [FAQ](#) | [Terms](#) | [Back to Top](#)

Copyright © 2003 IEEE — All rights reserved